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EDITORIAL

THE CONTROL OF DISEASES OF DAIRY CATTLE

THERE has been launched in this country a voluntary scheme for the control of some of the major diseases affecting dairy cattle, whereby the veterinary practitioner, and the farmer, assisted by laboratory workers, will unite in the carrying out of measures designed to prevent losses throughout the country. In this Journal we have commented not a few times on the necessity to control some of the diseases in cattle and on the part which the veterinary profession must play in such work. We are more than ever convinced that with an agreed policy of disease control, each party participating to the best of his ability, the incidence of disease and, therefore, the huge economic loss which occurs to-day, can be considerably curtailed. With the exception of tuberculosis, for which no special provision is made in the scheme, the other important diseases are covered —mastitis, contagious abortion, infertility and Johne's disease. There is little doubt that some people would have liked to include tuberculosis in a control scheme : there are measures now in operation covering the detection and removal of the actual spreaders of the infection and one can well see practical difficulties of further methods of control at the present time. It is to be hoped that when the country returns to more normal conditions a big drive will be made to reduce the incidence of tuberculosis by methods which are even now the subject of investigation.

The control of the four diseases mentioned above is based on present-day knowledge of the most appropriate and effective measures indicated by research in this and other countries. The last word in these subjects is still to be said, and it may be some considerable time before further information is forthcoming concerning them; in the meantime, it behoves all parties conscientiously to apply the measures agreed upon, for experience has already proved in different parts of the world that beneficial results will follow.

Mastitis has been the subject of much study throughout the world. This was to be expected from its prevalence in every country where dairy cattle are kept and are required to produce milk in economic quantities. Research has led to a clearer understanding of the causes of the disease and

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to some of the precautions which can be carried out in attempting to prevent its spread in a herd. There is much evidence to support the adoption of hygienic measures in the cowshed, during milking, etc., as a means of preventing further infection, while the early detection of affected animals by an examination of the fore-milk, even before clinical symptoms are present, and the isolation of such animals has proved its value in different herds. It may be that the periodical bacteriological examination of quarter samples of milk and the subsequent isolation of animals proved to contain certain types of organisms in the samples have not resulted in the total eradication of mastitis from the herd. There is still much to be done concerning the causes of the spread of the infections but by the practice of the measures envisaged in the control scheme we are travelling a considerable distance in controlling the gross spread of the disease. Curative measures are also to be practised; for example, the use of sulphanilamide is recommended and in order that its use may be an economical proposition, provision is made for supplies at quite a low cost. Further, the irrigation of the udder with dyes of the acridine series will be carried out in cases in which the veterinary practitioner considers beneficial results will follow: in some cases the treatment will doubtless be administered in the acute stages of the disease, but probably in the majority of cases the irrigation or injection will not be carried out till the dry or drying-off period. Laboratory assistance will be given to establish the nature of the infection in the herd.

The control of contagious abortion concerns the two methods already practised in this and other countries, viz., the eradication of the infection from the herd together with measures to prevent its reintroduction and the use of vaccines to establish a resistance to subsequent infection. In this and other countries it has been shown that it is possible and, in some cases, easy to rid an infected herd of *Br. abortus*, provided that some fairly simple rules concerning the application of the agglutination test, its interpretation and the subsequent disposal of positively-reacting cattle are practised. Research work has shown the necessity to use a standard antigen, the methods of interpretation of the results of the test and the time when tests should be made. It has been found, however, a matter of some considerable difficulty to maintain such a non-infected herd free from infection, especially in some areas. The precautions to be taken are distinctly irksome, especially in those herds which are not entirely self-contained, with the result that disappointments are experienced and when infection is introduced into the now susceptible herd the spread of the disease may be extensive. For these and other reasons attention has been focused for many years on the evolving of a satisfactory method of vaccination. Up to the present there does not appear to be any reliable evidence in the field that a vaccine prepared from killed *Br. abortus* cultures elicits the necessary degree of resistance to infections as met in every-day practice. The use of cultures of full virulence in the preparation of the vaccine cannot be recommended because of the risk of setting up an infection in the treated animal and, therefore, in the herd. Attention has been given to the use of vaccines produced from attenuated living cultures and there is field evidence to support claims that their injection is followed by a resistance to further infection of high order, while persistent infection does not take place. It is essential in this work, as in all biological

work, to have at the disposal of producers of vaccines cultures of the necessary organisms concerning which much knowledge is available. The use of any other cultures can never be permitted on scientific grounds. For contagious abortion control two such cultures of *Br. abortus* are available to-day—the American strain 19 and the British strain 45/20. It is understood that these strains only are to be used in the preparation of vaccines for cattle in the new control scheme. The merits of the two vaccines have been subjects of articles in the Veterinary Press in this and other countries. While it seems entirely logical that this decision has been made it must be pointed out that, following further research, strains of the organism more suitable for use in the field may be forthcoming and that, after full field trials with them, there would be no reason to continue the use of the present strains. There is no finality in this type of work and we must always strive for the best results. By a carefully planned vaccination campaign in a herd it should be possible to set up resistance to contagious abortion of a degree that the subsequent introduction of infection into the herd would do little damage.

Infertility in cattle has been shown to be a cause of very high economic loss and its control, except in some few instances, has never been seriously attempted. Its causes are numerous, varying from simple infections of the genital tract following contagious abortion to much more fundamental physiological causes. It is only within comparatively recent times that attention has been given to the various causes and their treatment, and though our knowledge may still be very incomplete we can claim to have made considerable progress and to be able to control infertility in many instances. The keeping of records of calvings, heat periods, services, etc., by the farmer will certainly assist the veterinary practitioner in his work, and the periodical examination of all cattle which have failed to conceive, investigation to ascertain the cause and the carrying out of the appropriate treatment should go far to reduce the incidence of the number of barren cows and heifers. The recognition of pregnancy in cattle is an essential part of the control of infertility. We have drawn attention in previous numbers to the great necessity of veterinary practitioners to become familiar with the techniques necessary for these operations and would repeat that it is his duty at this time to take advantage of every opportunity afforded to him to acquire any new knowledge available to-day and to revise his acquaintance with techniques and methods which he might not have been in the habit of practising to any great extent. Infertility in the bull and its various causes and methods of diagnosis must also be studied and considered in any scheme of control as well as the part played by the bull in transmitting infections likely to result in infertility in the females, e.g., trichomoniasis. With careful study and consideration of the causes of infertility in a herd and the adoption of suitable treatments the losses are bound to be reduced with resultant benefits to the farmer. He will be able to arrange his breeding programmes to suit his requirements. The nation will benefit in the form of increased milk yields, especially at seasons when it is most required.

In the control of Johne's disease there may be less of a positive nature than with the others. The cause is known and its method of spread is recognised. The diagnosis of the disease, especially in its early stages, is probably not so

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accurate as in the case of other infectious conditions. Advantage can be taken of the knowledge that older cattle may excrete the organism in the absence of clinical symptoms and that young stock are highly susceptible.

Infection may be controlled by keeping apart the older from the young stock. Strict hygienic principles should be adopted, e.g., the prevention of soiling of drinking places. While we may not yet be satisfied with methods of diagnosis it will be only a matter of time until diagnostic agents are available which can be standardised to a required potency. Articles have recently appeared in this and other journals which point the way.

We look forward with great hope to the results of the application of the scheme of control. Its success will depend largely on full co-operation of all parties concerned.

IS COMPLETE MECHANISATION AN ADVANTAGE?

Major-General John K. Herr,* Chief of Cavalry, U.S. Army, at a meeting of the Horse and Mule Association of America, held in December, 1941, stated:

"From the most reliable sources available it appears that the Russian Army has more than 1,000,000 animals, the Japanese Army has more than 375,000, and the German Army includes, as a conservative estimate, more than 960,000 animals."

"At that time the American Army had some 50,000 animals in service."

In view of the above statement by a recognised authority, one would ask: Has the animal side of our own army been neglected? Is the policy of mechanisation carried too far, especially if one takes into account the vast and varied fields in which operations are proceeding at the present time and the new zones which may be opened up in the future?

The days of the spectacular cavalry charge may be gone, but this was only one small item in the service which has been rendered by animals to our arms in the past. The horse, the mule, the donkey, the bullock and the camel have all served us with great efficiency in previous campaigns, particularly in regard to transport. It is common knowledge that horse transport played a great part in the German plan when France, Holland and Belgium were conquered in 1940. The mechanised spearhead was supported and supplied by the aid of horse-drawn equipment and supply trains. It is doubtful if the advancing mechanised shock troops could have attained their objective or have been kept supplied with the all-essential oil if they had not been supported in the rear by reliable supply columns which derived their energy from sources other than oil. Mounted troops were used to take over and hold localities which had been reduced by the mechanised battering rams. The latter were then free to continue to advance.

Mechanised transport and equipment are only of supreme advantage when the wheels are turning to utmost capacity. This is also true in civilian life. If movement is slowed down, or if stasis occurs, the advantages of the machine are obliterated.

Horses saved us in the last war, first in the retreat from Mons, where the cavalry under the direction of that great cavalry leader, Sir John French, held

*Booklet 265, Horse and Mule Association of America.

off and subsequently turned an immensely superior German force. The ultimate collapse of the enemy was in no small measure due to the skilful use of our cavalry in Mesopotamia under Sir Robert Cassels and in Palestine under Viscount Allenby. The distances covered were stupendous, the havoc they caused colossal, and their victories marked the beginning of the end. That great soldier, Earl Haig, attributed the Allies' victory to be in no small measure due to their superiority in horses and horse management.

Now the war of 1914-18 was not by any means the "animal" war as it is so often described. Anyone who served in any of the theatres of war can substantiate this fact, for there were myriads of lorries and tractors used. The outstanding feature was that the two types of power were employed so that full advantage could be taken of their services. When one was more efficient than the other there was no hesitation in its employment. From personal knowledge I can state that on one line of communication, 120 miles in extent, mechanised supply columns failed to keep the advanced forces efficiently supplied. One saw the ludicrous farce of mechanised vehicles being used to bring up petrol, three-quarters of which was consumed by the vehicle itself in the journey to and fro. Fortunately the D.D.S. & T. was a man of great adaptability. Ten relay stations were established and mule transport (i.e., A.T. carts) substituted for the motor vehicles. The carts did the through journey, the mules at each station being responsible for their own zone. Convoys were kept on the move, an endless chain established, and supplies arrived at their destination with a regularity which matched that of a well-organised railway.

It is not my purpose to decry the mechanisation of our arms. In modern war it would be ridiculous for a civilian to make such assertions, but with respect one can ask: Should mechanisation be carried to almost 100 per cent.? Are there not many duties which could be done with efficiency and certainly with great saving to the public purse by animal-drawn power? Could not much of the transport work in and about camps, between depots and in the support areas in the field, be relegated with advantage to animal power? Great savings of oil would be effected and oil is said to be the life-blood of modern war.

Could not greater use be made of what might be called dual-purpose power in vehicles adapted to both forms of motive power? There may be occasions when mechanised traction fails owing to the state of the terrain or for other causes. How advantageous it would be to be able to switch over immediately to an alternative.

By the judicious use of animals a training ground could be established from which at any moment one could draw competent men and animals should the necessity arise.

Our Russian allies have given definite proof of the value of such a system. Moscow was threatened and in the opinion of most military experts nothing but a miracle could save the situation. A miracle did happen, but it was not a miracle in the traditional sense, i.e., a supernatural event, but one which followed sound planning. At the crucial moment the cavalry were released. It is said that 70,000 had been held in reserve for such an occasion. The tide was turned, and when the history of this war is written it may be that this triumph of the horse will rank with those of French, Allenby and Cassels.

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General Articles

THE COLLECTION OF SEMEN AND ARTIFICIAL INSEMINATION IN THE DOMESTIC FOWL

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THE development by Burrows and Quinn (1935, 1936 and 1937) in the U.S.A. of a simple technique for obtaining semen from the male fowl has opened up several possibilities in the application of artificial insemination to this species. These authors have also used the method in turkeys, whilst Owen (1942) reports the successful insemination of pigeons and doves. Bonadonna (1939) has obtained semen from a number of small birds, including canaries and finches.

After collection and suitable dilution of the semen, artificial insemination could be used in poultry, as in mammals, as a means of utilising the services of progeny-tested sires on a wider scale than is possible under the natural system of mating. Under war-time conditions the method might conceivably be applied to make good any shortage of high-class cockerels that is likely to arise. Artificial breeding of poultry and other birds for experimental purposes might also be undertaken under laboratory conditions, where, owing to limitation of space, it is impossible to practise natural mating. The method also provides a convenient means for obtaining material for the study of certain fundamental aspects of reproduction in avian species.

The earliest attempt at the artificial breeding of fowls was made by Ivanov (1913). He records that he used the semen of a cock for the insemination of hens which had been isolated from the male for about three weeks. From these hens 43 eggs were incubated, 10 of which proved fertile. Quinn and Burrows (1936) in experiments involving the crossing of different breeds of fowls report that artificial insemination gave 97 per cent. fertility and 82 per cent. hatchability, whereas the controls gave 93 per cent. fertility and 81 per cent. hatchability. Jeffrey (1941) states that the weekly insemination of 0.1 c.c. per hen gave an average fertility of 82 per cent. Equally favourable results have apparently been obtained by other workers with diluted semen. Thus Bonnier and Trulsson (1939), comparing undiluted semen and semen diluted with Ringer solution, state that 30 per cent. semen gave better results than undiluted, and 10 per cent. semen gave as good results as undiluted semen. Monro (1938), on the other hand, reports that sperm diluted with Russian mammilian sperm-dilutor gave poor results. He states that probably about 100×10^6 sperms must be placed in the vagina of the hen before fertility will remain at a normally high level for a period of ten days.

The work recorded in this paper was undertaken mainly with a view to obtaining information on the practicability of artificial insemination in poultry. It was hoped at the same time to obtain from an aged R.I.R. cock, which was available for our experiments, and which was known to transmit high egg-laying capacity to his daughters, the greatest possible number of progeny.

Methods and Material

Cock.—The cock (R.I.R.) was hatched in 1939 and was thus three years old at the time of the experiments. He had previously been used for natural mating during the 1940 and 1941 breeding seasons. It was known that he had given good results both as regards fertility and the egg-laying qualities of his female progeny.

Hens.—Rhode Island Red yearling hens were employed. These birds had not been previously mated as pullets and had never at any time been run with a cock bird.

Housing and General Management.—The hens were housed in slatted floor houses situated in large grass runs. The cock was allowed ample grass range. He was within hearing but not within sight of hens.

Feeding was on orthodox lines. Weather conditions during the time of the experiments (March, 1942) were very severe, and on some days snow and hard frost were experienced.

The Collection of Semen.—The method adopted for the collection of semen was similar to that described by Burrows and Quinn (1937) for the domestic fowl and the turkey. In this technique the erection of the male copulatory organ and the ejaculation of semen is stimulated by applying gentle massage to the abdomen between the gizzard and the pelvic bones. When the bird has become thoroughly accustomed to handling, massage for about 30 seconds generally causes erection and protrusion of the copulatory organ. Almost immediately with continued massage a vigorous orgasm is produced and about 0.5 to 1 c.c. of thick milky semen is ejected from the bulbous ducts of the organ. At the instant of orgasm and ejaculation the copulatory organ is gripped between the thumb and forefinger (see Fig. 1), so that the bulbous ducts can be completely milked out. This usually yields a further 0.5 c.c. of semen. Further massage is then applied to the abdomen and the bird stimulated to make a further ejaculatory response. No semen is ejaculated at this time, but a small amount is obtained when the bulbous ducts are milked as before. Further ejaculatory responses are now elicited, followed by milking, until no more semen can be obtained. With the cock used in our work, the total yield of semen on any one day was from 1 to 2 c.c.

In collecting the semen we obtained the impression that a greater quantity of semen was obtainable if the cock had first been placed in the cage of a laying battery adjacent to hens for a period of 15-30 minutes. It was also found that the bird was more easily stimulated after he had been used for several collections and was thoroughly accustomed to handling. On occasion, and especially at the early trials, the bird voided ureteral excreta at the same time as the ejaculation was made. Such contaminated serum was never used for insemination.

Collections were made from the cock every second day over a period of approximately one month. The amount of semen obtainable after a one-day rest was generally greater than when collections were made every day.

The semen was collected in a glass funnel held by an assistant below the bird's vent. The method is clearly illustrated in Figure 1. For convenience in handling, the stem of this funnel was shortened and fitted into a rubber cork; the lumen of the stem was filled by paraffin wax.

After collection the semen was transferred from the funnel to a small test tube. No special precautions were taken for the preservation of the semen before insemination into the hens. The interval elapsing between collection and insemination was 15 to 30 minutes. Before insemination the semen was diluted with normal saline or Ringer solution in the proportion of one part semen to one part of the diluent.

The Technique of Insemination.—For the injection of semen a 0.5 c.c. all-glass syringe was used.

In our first experiments the semen was deposited in the cloaca of the hen, but preliminary incubation tests showed that very poor fertility resulted from this method of insemination.

In later experiments we adopted a technique similar to that described by Quinn and Burrows (1936), whereby the external orifice of the oviduct is exposed and the semen injected directly into the oviduct (see Fig. 2). In order to expose the oviductal orifice the hen is held head downwards under the left arm with her back against the operator. Pressure is exerted on the lower abdomen with the left hand; this causes a slight protrusion of the vent. Further pressure is now applied above and below the vent with the thumb and fingers of the right hand. The combined pressure causes the oviductal orifice, and usually also the intestinal opening, to be extruded through the vent. The former is easily recognisable by its larger size and its appreciably bigger sphincter; it is situated on the left of the intestinal opening. It was found that exposure was most easily effected soon after the bird had laid; it was, therefore, arranged to inseminate the birds as they were released from the trap-nest.

Exposure of the oviduct in the way described did not appear to cause any deleterious effects on the bird. It was, however noted on releasing the birds after handling that their combs were deeply congested, and that frequently they staggered for a few steps when placed on the ground; these symptoms quickly passed off.

After exposing the entrance to the oviduct, the tip of an 0.5 c.c. all-glass syringe filled with semen is inserted a short distance into the lumen of the oviduct. The pressure on the abdomen is then released and the oviduct allowed to return to its normal position, while at the same time the syringe is allowed to go forward so that its tip remains in the oviduct. The piston of the syringe is then slowly depressed and the semen injected directly into the oviduct.

The amount of diluted semen used for each insemination in our work was 0.1 c.c., equivalent to 0.05 c.c. of undiluted semen. Each bird received this dose at least once a week. In many instances, when plenty of semen was available, some birds received two or even three inseminations in the course of a week.

Incubation of the Eggs.—In the present experiments the first eggs were taken for incubation 24 hours after insemination had been carried out. The maximum interval after insemination at which eggs were taken for incubation was 14 days.

Data given by Jull (1930) indicates that the time elapsing between ovulation and the passage of the egg through the cloaca is approximately 21-27 hours. Assuming, then, that fertilisation is effected shortly after ovulation and before much albumen has been added to the ovum, the period of 24 hours appeared to

FIG. 1.—Collection of semen—squeezing out the bulbous ducts.

FIG. 2.—Injection of semen into oviduct of hen.

us to be the earliest possible interval after insemination at which fertilised eggs could possibly be laid. This assumption is confirmed by the reports of various workers (cited by Jull, *loc. cit.*) who practised individual matings under the natural method of breeding.

The eggs produced by the artificially inseminated hens were incubated in a large forced-draught cabinet incubator along with batches of eggs fertilised in the normal way. Conditions of incubation were, therefore, identical for both types of eggs. Since different and mostly younger males were used to fertilise the eggs produced by natural mating, fertility results from the two types of eggs were not comparable. It was noted, however, that the percentage of fertile eggs which failed to hatch was almost identical in both cases. The chickens produced by artificial insemination were normal in every way.

Results

Over a period of approximately one month 39 hens were artificially inseminated at varying intervals with 0.1 c.c. of diluted semen (equivalent to 0.05 c.c. undiluted). In general, there was a tendency for the birds receiving the more frequent inseminations, two or more in one week, to produce the greater number of fertile eggs. Of the 39 hens used in the experiment, 33 produced one or more fertile eggs, whilst six birds laid eggs which were consistently infertile. The fertility results for each lot of eggs placed in the incubator are summarised in Table I.

TABLE I

Lot	No. of Eggs Incubated	No. of Eggs Fertile	% Fertile
I	42	1	—
II	78	8	7.69
III	112	50	44.65
IV	132	49	37.12

TABLE II

LAYING RECORDS OF 10 HENS USED IN THE EXPERIMENT

No. of Pen or Hen	(Days of Month) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
1855 ...	S S S S S S S F 1 1 1 1 F 1 1 1 F 1 1 1 F 1 1
1861 ...	S S S S S S S 1 1 1 1 1 1 1 1 F 1 F 1 1 1 1 F 1 1
1856 ...	S S S S S S S 1 1 1 F 1 1 1 F F F F F F F F F
1990 ...	S S S S S S S 1 1 1 1 1 1 F F F F F F 1 1 1 1 F 1
1559 ...	S S S S S S S 1 1 1 1 F F F F F F 1 F F 1
1560 ...	S S S S S S S 1 F 1 1 1 F 1 1 F 1 1
1571 ...	S S S S S S S 1 1 1 1 1 1 1 1 1 1 1 F F 1 F
1562 ...	S S S S S S S F F F 1 1 1 F 1 1 F F F F F 1
1579 ...	S S S S S S S 1 1 1 1 1 1 1 1 1 1 1 1 1
1866 ...	S S S S S S S 1 1 1 1 F F F F 1

I = Infertile egg. F = Fertile egg. S = Inseminated.

The method of insemination practised with Lots I and II consisted in simple deposition of the semen within the cloaca of the hen. For Lots III and IV the semen was injected directly into the oviduct.

The earliest interval after insemination at which a fertile egg was laid was 48 hours. This occurred in only one instance; more usually about one week elapsed, during which time two and sometimes three inseminations were given, before the first fertile egg was laid. The eggs laid subsequent to this were not all fertile; in the majority of cases there was an irregular alternation of fertile and infertile eggs. Table II shows typical laying records of 10 of the hens used in the experiment.

The longest interval after the last insemination at which a bird produced a fertile egg was 11 days.

Discussion

It is clear from the results obtained in this experiment that when a small dosage of semen is employed it must be injected directly into the oviduct before anything approaching satisfactory fertility can be expected.

The fertility rate obtained in our experiments is lower than is normal with natural mating; it is also considerably lower than some workers, notably Quinn and Burrows (1936), have reported for artificial insemination. We believe that there are several possible explanations of the discrepancy. Firstly, the dosage of semen employed by us was too low; twice the amount, i.e., 0.1 c.c. of undiluted semen, would probably have given a better fertility rate. Secondly, the work was carried out during a period of extremely cold weather and, since no special precautions were taken to maintain the temperature of the semen at or near body-heat between its collection and injection, it is possible that the sperm may have suffered some deleterious effect as a result of temperature shock causing too rapid cooling. A third possibility is advanced age of the cock used in this work. According to Jull (1930) the reproductive value of male fowls in the great majority of cases "declines rather rapidly after the first year, due largely to the fact that as the male grows older his ability to produce a high percentage of fertile eggs declines. In other words, cockerels usually produce a higher percentage of fertile eggs than when they become yearlings, and thereafter they are relatively of little value." Unfortunately, at the time when our work was in progress the opportunity could not be taken to test this point by mating the cock to a number of hens in the natural way.

Our results show that the greatest number of fertile eggs was produced in the third and fourth weeks of the experiment after a number of inseminations had been given. The average duration of sperm viability in the oviduct of the hen is probably 14-21 days. These two facts considered in relation to one another suggest the possibility that a certain minimum concentration of sperm is necessary at the top of the oviduct before a satisfactory level of fertility is attained. A similar conclusion is arrived at by Hammond (1940), who states that "it is not until large numbers of sperms have accumulated at the tops of the oviducts, as a result of several matings, that all the eggs laid are fertilised." From this it is clear that had we allowed a longer interval to elapse before taking the first eggs for incubation, and also by allowing several inseminations to take place in this interval, a much higher percentage of fertility would have been

obtained. Since, however, we were anxious to determine the shortest time after insemination at which a fertile egg may be laid, we accordingly collected eggs for incubation 24 hours after the first insemination had been made. In practice we suggest that a week should elapse between the first insemination and the taking of the first eggs for incubation; during this time a total of two or three inseminations should be given. In the subsequent weeks only one insemination need be given.

Observations by many workers (see Hull, Hammond) indicate that in flock or pen mating where 8 to 15 females are usually allotted to one male, a cock will tread 20 to 40 daily. According to Hagedoorn (1939) this is more often than is necessary for a "good percentage" of fertile eggs. If this statement is correct, then a considerable amount of the cock's energies are dissipated in unnecessary mating. In the case of a particularly valuable cock his services could be strictly controlled by making use of artificial insemination, a method which would at the same time allow of the bird being mated to a much larger number of females than would be the case under the natural, but unrestricted, breeding systems. Thus, assuming that a cock yielded 1 c.c. of semen at daily collections, and employing a dosage of 0.1 c.c. per hen every 5 to 6 days, this would enable a cock to be bred to 50 to 60 hens, i.e., approximately four to six times the number of hens were the natural method practised.

The possibilities of the use of artificial insemination in poultry under field conditions in this country have as yet not been explored. The method might well be utilised by pedigree breeders in order to obviate the necessity of keeping their birds in small fixed breeding pens which are expensive to erect and difficult to maintain owing to the risk of the ground becoming fowl sick. Breeding hens could be kept on free range and artificially inseminated as they are released from the trap nests. Along these lines it is not difficult to visualise further possibilities for artificial insemination in the progeny-testing of cockerels without recourse to elaborate pen lay-outs and expensive equipment. The method also presents possibilities for the general improvement of poultry stocks by the distribution of semen from proven males kept at a state-aided progeny-testing station, which the Poultry Technical Committee of Great Britain, 1938, suggested should be set up for "the breeding of the highest quality foundation stock of known history and character."

Summary

1. A method is described for the collection of semen and the artificial insemination of domestic poultry.

2. The possible applications of artificial insemination in poultry in the light of results obtained in preliminary trials are discussed.

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WATER—ITS RELATION TO HEALTH AND DISEASE

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"Read not to contradict and confute, nor to believe and take for granted, nor to find talk and discourse, but to weigh and consider."
Francis Bacon.

WATER is suspected seldom as being the cause of disease in livestock, especially if the supply has been drawn from the same source for a long time and there had not been outbreaks of acute illness. Farmers may often complain that their stock present an unthrifty appearance notwithstanding an ample supply of water, wholesome food and apparently healthy surroundings. As a rule it is only when conditions have become grave that the veterinary surgeon's advice is sought. His investigations may draw attention to the water supply and an explanation may be found which would explain the malnutrition of previous years, i.e., polluted water. Pollution of the water supply is a matter of the highest importance to the stock owner and to my mind it has not received the attention which it rightly demands.

It is a well-known fact that animals can drink water which from the human point of view would be ranked as highly suspect. This relates to healthy animals but if disease should make inroads on the animal's constitution then the effects of an impure water supply are clearly seen.

The danger of such water depends upon:

(1) The quantity of organic matter.
(2) If the organic matter is of animal or vegetable origin.
(3) The activity of the state of putrefaction.

Animal matter is more dangerous than vegetable and when in a state of decomposition may develop products as deadly as arsenic. Dr. Sims Woodhead drew attention to ptomaines, bacteria and their poisons.

Bacteria in Nature

Bacteria have their place in the natural order of things quite apart from their action as producers of disease. They occur in myriads all around us, and are an absolute necessity for the carrying out of a great number of processes. They are some of the most important scavengers known. By their action they break up complex organic matter into much simpler substances, thus destroying dead and decaying animals and vegetables.

This process takes place not only on the ground but also within the alimentary tract in animal bodies. All putrefaction processes are caused by organisms. By

their action organic matter upon the surface of the earth or near the surface of the earth is oxidised, and by this means is made ready to act as food for plants. The plants in their turn serve as food for animals, and so the bacteria serve to keep up the balance of natural productions. How do microbes produce disease? Having realised that microbes are partly necessary agents in the scheme of nature, and partly destructive agents in the production of disease, we must look closer at the latter subject in order to understand exactly how a microbe disease is brought about. First it is necessary that the germs gain access to the animal. A germ only arises as the product of a pre-existing germ. No microbes are manufacturers out of nothing, nor do they arise in stagnant water, or drains, or sewage, nor under any other conditions, except so far as they are the offspring of microbes which preceded them. The sewage, etc., merely affords a convenient environment in which the germs may flourish. It therefore follows, and this is very important, that those germs which produce disease, and which never live apart from disease, are never found except where that disease has been. It is this fact that makes it possible to stamp out some epidemics absolutely or to rid a country entirely from some infections. It is this which makes justifiable the regulations of the authorities in dealing with disease in cattle and pigs.

Natural Protection from Organisms

From what we have already seen of the power and nature of germs the question naturally suggests itself: How is it possible that so many human beings and animals escape infectious disease at all? It would not be possible except for the fact that every living animal possesses some degree of natural resistance to the germs of disease. All have in fact a certain amount of inborn immunity and this is due partly to the protection afforded by the skin, partly to the action of various fluids and secretions in the body, still more to the capacity of the cells within the body of devouring microbes with which they come into contact. It has been shown that in mammalian blood there exists opsonins whose special function is to act upon any germs which gain access to the blood, so as to render these germs easily devoured by the white corpuscles.

Mr. Wynter Blyth, in his "Dictionary of Hygiene, and Public Health," says: "The bad effects of human sewage on cattle appears to be NIL." Such a conclusion, however, is certainly not warranted by our experience. That cattle will, as he observes, grow and fatten on the most sewage-trodden soil is a fact in the experience of most practical men, but it is equally true that sewage under certain conditions not only lowers the standard of health but becomes distinctly poisonous. It is questionable whether human sewage may not be a means of spreading tuberculosis in our dairy herds.

One cannot draw conclusions (general) from individual cases, but where one finds, as I have done, nineteen dairy cows suffering from tuberculous disease in the course of a year on a farm irrigated with sewage, the idea of sewage being a possible cause of the malady may reasonably be entertained as a starting point for future inquiry. It would be perfectly true to say that grass grown under the influence of sewage may be, and is, fed to cows for long periods without occasioning impairment of health, but it is quite another thing to aver that human sewage has no effect upon cattle.

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Acute poisoning sometimes proves fatal rapidly, as we have known cattle die in a few hours from its effects. Where it assumes a chronic form, the disease runs a slow and protracted course, extending over weeks and even months. In the former case the malady develops many of the clinical characters of anthrax; in the latter it is marked by continuous diarrhœa, often resulting in emaciation, exhaustion and death.

Action of Plant Life

In a short but interesting paper, "Vegetable Growths as Evidence of the Purity and Impurity of Water," by A. W. Bennett, the vegetation of running streams is classified under four heads: (1) Flowering plants; (2) Fungi; (3) Algæ; (4) Characeæ.

The importance to be attached to flowering plants in our ponds and streams is centred in the fact that the vital phenomena are the same for green-water plants as for green-land plants, and the process of assimilation is far more energetic in the daytime than that of respiration. They must be giving off oxygen constantly into the surrounding water, and their influence on its purity must be uniformly favourable. "Moreover," says Bennett, "none of this class of plants are able to withstand the injurious effects of a large amount of fæcal or other pathogenic organic impurities in the water, and their presence, if in a healthy flourishing condition, must be regarded not only as beneficial, but as a sign of the comparative purity of the water."

Quite the reverse are the indications of "Aquatic Fungi." Excluding bacteria, the same author remarks: "The number of aquatic fungi is small, and of these the only one which practically comes into consideration in relation to the purity of water supply is the so-called "Sewage fungus," *Beggiota Albu*. Since all fungi which are not parasitic are saphrophytic, i.e., derive their nourishment from organic bodies in a state of decomposition, their occurrence is in itself sufficient evidence of the presence, in the water in which they grow, of putrid or decomposing organic substances, and since they do not assimilate in the proper sense of the term, i.e., do not decompose carbon dioxide and produce carbohydrates, or other similar compounds, they can exercise no purifying influence on the water by the disengagement of oxygen."

The appearance presented by the sewage fungus is that of a dirty yellow jelly-like looking layer covering the bottom and sides of the watercourse in which it occurs. It is found plentifully in drains which carry off the effluent water of sewage farms, and is especially abundant where the current is slow and the watercourse tortuous. Wherever it occurs it is an unfailing sign of the presence in the water of a large quantity of deleterious organic compounds. Microscopically examined, it is found to consist of delicate soft filaments, interlacing each other in all directions.

The algæ of our ponds and streams form a large and interesting group of aquatic plants, several of which would appear to exercise a marked influence on the purity or impurity of water, and by their presence to indicate in some degree the extent of its organic contamination. Algæ are best known to the ordinary observer in that form termed "blanket-weed." This, however, is the only one of the numerous examples which abound in our rivers and ponds. The higher algæ consist of closely packed masses of long green mossy filaments, which form

a broad sheet upon the surface of the water. Others are much simpler in their organisation, and are very minute, so much so that the entire plant may consist of a single belted cavity only of microscopic dimensions. Between these two extremes of development there are intermediate forms of great variety.

These plants Bennett classifies under the heads: (1) blue-green algæ, and (2) chlorophyll green algæ. Of the former he remarks: "The amount of oxygen which they give off into the water is exceedingly small and they can exercise no appreciable purifying influence, while in their decay they give out noxious and fœtid gases, and their presence in the water of any considerable quantity should be regarded as rendering it unfit for domestic purposes."

"Of the chlorophyll green algæ, the family confagatal are extremely sensitive to organic impurities of a putrescent character; they rapidly perish in water that is not well charged with oxygen and when found in any quantity, or, at all events, if occurring in the reproductive condition, it may be taken for certain evidence that the water contains no considerable quantity of deleterious organic ingredients. They give off into the water an appreciable amount of oxygen and thus contribute to purify it." A striking illustration of the purifying influence of plant life on water arose quite accidentally some years ago in India, when all aquatic plants were removed from the water tanks. As a consequence the water, which before was good and wholesome, became unfit, for although the higher species of algæ, especially "blanket-weed," give out a considerable amount of oxygen to the water in which they grow, when they exist in large amount and undergo disintegration and decay, they may prove a source of dangerous pollution.

It is recorded by Francis, of Adelaide, that in 1878 the lakes which form the estuary of the Murray river contained a conferva in such quantities as to render the water poisonous to farm animals. He believed it to be the *Nodularis Spumigera*, a plant allied to *Probococcus*. It forms a thick scum, like green paint, some two to six inches thick, and as pasty as porridge. It is swallowed by cattle when drinking, especially such as suck their drink from the surface, like horses. On being ingested it acts as a poison and rapidly causes death.

The symptoms shown were stupor and unconsciousness, the animals falling and remaining just as if asleep, unless touched, when convulsions came on and the head and neck were drawn by rigid spasm. Death took place in the case of sheep in from one to eight hours; in horses in from eight to twenty-nine hours. Dogs succumbed in from four to five hours; pigs in from three to four hours. On post-mortem examination all the scum was found to have been absorbed: the abdominal cavity contained a quantity of yellow serum: heart was flabby, and had around it a considerable amount of effused serum. The lungs, liver, and substance of the brain were healthy, but the outer membrane of the brain (*dura mater*) was congested. Blood throughout the veins and arteries, and in the cavities of the heart, was black and not coagulated, neither did it become scarlet on exposure to the air. Many sheep that died, on being opened presented the same appearances, all being without any signs of the plant in the stomach. "This," says Francis, "shows that it is rapidly absorbed. When the scum is left in wet pools and puddles, it decomposes rapidly, giving off a most horrid stench, like putrid urine or Archil in process of manufacture, but previous to its getting into that state it emits the smell of butyric acid, as does very rancid butter.

Pollution of Rivers

Nearly every mining and manufacturing process gives rise to an effluent refuse more or less deleterious to life. The existence of some of these forms of refuse is made known by the peculiar discoloration of the water into which they flow. Some rivers of Yorkshire are turned blue and various other hues by the effluent refuse of cloth-works; those of Cornwall are reddened by the washings of the tinplate manufactories, or turned white by impregnation with china clay, while in the coal-bearing districts they are blackened by the effluent from coal washing. Outward and visible signs, however, are not always available to make known the deleterious substances which pollute our waterways, and in such cases it is only by actual experience of their effects on living things that their presence becomes known. The absence of fish where once they were abundant, the disappearance of aquatic plants from the rivers and banks, are suspicious signs if not absolute proof of dangerous pollution.

My reason for presenting this dissertation on the pollution of water is to draw attention to a very important subject which has a great bearing on animal health. I hope that my effort will serve to promote discussion which in its turn may give a stimulus to organised research on a matter of great moment to animal husbandry.

Abstract

JOHNE'S DISEASE OF SHEEP*

By D. F. EVELETH, REBECCA GIFFORD and C. H. ANTHONY

SHEEP production has become so unprofitable in certain areas that sheep raising has been practically discontinued. The usual history in many of these flocks shows an early period of low mortality and good lamb and wool crops. Later the number of ewes dying increases, there is considerable loss of wool from shedding, and a decidedly lower lamb crop. The third phase is characterised by a low lamb crop, high suckling lamb mortality, and later death of most of the yearlings that survive the first year as well as death of many of the older ewes.

The symptoms described in most cases are characteristic. Following lambing or a period of feed shortage the ewes frequently develop anorexia with a mild to severe diarrhœa and rapid loss of weight. The sheep become very weak, are unable to stand, and finally die.

Post-mortem examination of these animals reveals a slight to heavy infestation of internal parasites. There is usually a mild to severe gastro-enteritis with some thickening of the intestinal mucosa. There may be some lymph nodes containing a thick yellow to green pus. Calcified nodules may be found in the intestinal walls, mesentery, lymph nodes, and liver. The usual diagnosis is "death due to parasitism."

Preliminary tests conducted in co-operation with representatives of the United States Department of Agriculture, Bureau of Animal Industry, showed that many sheep reacted positively to intradermic johnin. Post-mortem examination of many of these animals revealed acid-fast bacilli in scrapings from the intestinal mucosa.

* *Vet. Med.*, 1942. *XXXVII*, 241.

Bacteriological examinations of the abcesses found in some sheep have yielded pure cultures of organisms similar in many respects to the organisms comprising the *subtilis* group.

Johne's disease in sheep was first reported in the United States by Howarth and later by Butler. McEwen has made the most recent detailed study of ovine Johne's disease in the British Isles, where it was first reported by Stockman.

The veterinary practitioner has at his disposal two common procedures for diagnosing a condition such as ovine Johne's disease. He must depend on the history, symptomatology, and post-mortem examination, or he must have available a diagnostic testing agent. Avian tuberculin has been used for the diagnosis of Johne's disease in sheep and was found superior to johnin by Howarth. This test depends on a temperature reaction which may be slight. It is not convenient for large-scale testing by a single operator. It was, however, used successfully by Howarth and McEwen.

Intradermic johnin developed by the United States Department of Agriculture, Bureau of Animal Industry, appears to be the diagnostic agent of choice at the present time. Such a testing agent is necessary since the symptoms and gross pathology of Johne's disease may be very misleading.

Hutyra, Marek and Manninger list the following lesions of ovine Johne's disease: "On post-mortem examination the mucosa of the small intestine and sometimes also of the large intestine, is much thickened, but not corrugated; its surface is uneven and coated with large quantities of mucus. In the submucosa punctiform or linear hæmorrhages are present. The mesenteric lymph glands are moderately enlarged and their tissues infiltrated." Butler has presented evidence that the small intestine may be not only thickened but definitely corrugated in ovine Johne's disease. Howarth's description of Johne's disease in sheep stresses the thickening of the walls of the large and small intestines, as well as the thickening and folding of the mucous membranes.

McEwen mentions thickening of the walls of the jejunum, ileum, and cecum in this disease. He also points out that the intestines from sheep with Johne's disease break more easily than the intestines of normal sheep. In two cases he found acid-fast organisms in the abomasum and the ileum. Enlargement of the small lymph nodes adjacent to the areas of thickened intestine were considered by McEwen to be of more diagnostic significance than the enlarged mesenteric lymph nodes.

Post-mortem examination of the viscera of sheep from flocks having heavy losses, and in which acid-fast bacilli have been found, has indicated that the gross pathology is a very poor criterion on which to base a diagnosis. The visible lesions produced by Johne's disease are similar in many respects to those produced by other factors causing the various types of gastro-enteritis.

The abomasum presents varying degrees of gastritis. The inflammatory reaction with the thickened mucosa and excessive amounts of mucus can be caused by stomach worms as well as by Johne's disease. Smears from the region of the pylorus frequently contain organisms similar to the Johne's bacillus in their staining properties and morphology.

The duodenum is usually streaked with raised folds of the mucous mem-

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brane, the crests of which are definitely red. There is generally an excess of yellow to grey mucus. Sometimes the reddened areas cover the entire mucous membrane of the duodenum. In the jejenum a similar condition prevails except that in the region of the Peyer's patches there is more of a tendency for an increased thickening of the area.

The ileum, especially in the lower portion, often presents reddening with excess mucus. In the lower ileum there are more nodules produced by the *O. columbianum* larvæ, so that thickening of the gut wall due to Johne's disease is masked by the issue reaction caused by the parasites. In many cases there are so many nodules in this area that it is impossible to find any normal appearing tissue. In some cases the crests of the folds of mucous membrane are not hyperæmic and may even appear anæmic.

The ileo-cecal valve and cecum are the areas most frequently involved in both Johne's disease and nodular worm disease. The inner surface of the cecum frequently presents so many nodules that if small folds were produced by the Johne's bacillus they would be included in the thickened tissues surrounding the nodules. Large reddened areas in the cecum are very common.

The anterior portion of the colon is often thickened, but as a rule it does not present the reddened areas more commonly found in the small intestine. However, in some cases red crested folds are found in this area and also in the remaining portion of the large intestine and rectum. The mesenteric lymph nodes are slightly œdematous. Dependence on the gross pathology of the lymph nodes for the diagnosis of Johne's disease is frequently misleading, due to the presence of œdema caused by parasitism and micro-organisms other than Johne's bacillus. However, it is frequently possible to demonstrate acid-fast organisms in the lymph nodes of the sheep.

A very interesting exception to the above description of ovine Johne's disease is illustrated in the following case: An eight-year-old ewe was introduced into a flock May 23, 1941. On July 25 an intradermic johnin test revealed very slight thickening of the caudal fold at the site of the injection. The ewe was in a moribund condition with laboured breathing and a mild diarrhœa. She was killed for post-mortem examination. The symptoms were probably caused by abscesses in the turbinate bones and a heavy infestation of lung worms.

The stomach and intestines presented no visible thickening or reddening of the mucous membranes. There were no large nodules in the intestines from nodular worm infestation. Acid-fast organisms were demonstrated in several smears prepared from the ileum, ileocecal valve, and the cecum.

Uncomplicated Johne's disease in sheep under field conditions is probably never encountered. The symptoms vary from flock to flock and in each case it would be just as logical to ascribe them to another disease or to parasitism as to Johne's disease. In flocks with a high percentage of reacting animals loss of wool is common and intermittent diarrhœa is present. Several flock owners have reported a high incidence of lameness in both lambs and mature sheep but in these flocks the presence of a mineral deficiency cannot be eliminated. Other symptoms of Johne's disease include extreme emaciation, lactation failure, excessive thirst, and weakness.

In certain cases sheep exhibiting all of these symptoms have failed to react

to intradermic johnin and it has been impossible to demonstrate acid-fast organisms in the tissues. The opposite condition, too, has been encountered. In some flocks, old sheep in excellent condition have reacted to intradermic johnin and the organisms have been demonstrated.

The combination of severe parasitism and Johne's disease seems to be one of the most serious conditions found in field outbreaks. An example of this combination can illustrate the problem confronted by the livestock owner and the veterinarian. A small flock of 28 ewes and two wethers was kept on a small farm in north-west Arkansas. During the fall and winter of 1940-41, 17 ewes died. The histories were all similar. Either just before or just after lambing the ewes would develop a severe diarrhœa, lose weight, finally become very weak, and die. The flock was observed March 24, 1941, and an old ewe was killed for examination. She was found to be heavily infested with *H. contortus*. The intestines presented no lesions suggestive of Johne's diseases although acid-fast organisms were demonstrated in the tissue smears. The sheep were treated by the owner with Nema capsules and no further losses were reported.

This flock was tested with intradermic johnin May 9, 1941. At this time 12 of the 13 mature sheep reacted to the test. These data suggest the possibility that Johne's disease so weakened many of the sheep that they readily succumbed

TABLE I

*Intradermic Johnin Test on Sheep Flocks,** 1941

Flock number	Number tested	Number reacting
1	5	1
2	5	5
3	66	42
4	221	97
5	19	14
6	48	17
7	73	21
8	10	3
9	49	19
10	2	1
11	36	18
12	20	8
13	36	20
14	32	15
15	79	49
	701	330

47 per cent. reactors.

* Flock No. 8 was composed of 51 sheep. Ten typical sheep and lambs were tested. Flock No. 2 (five sheep) were added to flock No. 3 by purchase.

to the parasitism. It is also important to note the very low percentage of lambs. There were only six living lambs from 11 ewes. Two of these lambs reacted to the johnin test. The owner reported in July, 1941, that all sheep were doing well. This flock was observed in January, 1942, and all sheep were in very good

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condition. They were tested again in February, 1942, and at this time 11 ewes had produced 12 living lambs. Of the 11 ewes, one ram, and five yearling ewes, there were 10 reactors.

Testing in 1940 indicated that many sheep reacted to the intradermic johnin test. Following the demonstration of organisms indistinguishable from *M. paratuberculosis* in several cattle and sheep dying with symptoms associated with Johne's disease the necessity for a diagnostic agent was established. Retesting 78 positive sheep showed that 74 again reacted. It was thus established that the intradermic johnin test has a high degree of reproducibility. Several flock owners disposed of their reactors which prevented repeated tests on many of the same individuals.

The number of sheep tested and reacting to the intradermic johnin test in various flocks is given in Table I. Lambs and mature sheep are considered together in this table.

The intradermic johnin test as applied to sheep is essentially the same as for cattle. The caudal fold or the vulva appear to be the best site for the injection. Sheep that are docked very close sometimes have no caudal fold. Such sheep can be injected near the anal ring or in the vulva. Tests read at 24 or 48 hours often have not attained the full size that they show at 72 or 96 hours. Routine tests are read 72 hours after injection.

The interpretation of some reactions presents a difficult problem. The clearly negative test is shown by the complete disappearance of the swelling at the site of injection. If the area is carefully cleaned and care is used in making the test there is practically no evidence of the injection after a lapse of 24 hours.

Many sheep respond to the johnin with a swelling which may be either circumscribed or diffuse. The diffuse reactions are usually hot and painful, and they can often be determined by observation alone.

The most difficult type of reaction to evaluate is the slight thickening of the dermis which may contain a very small circumscribed nodule of 2 to 3 m.m. in diameter. In several cases these very mild reactions have been observed in clinical cases of Johne's disease.

By necropsy and the examination of intestinal smears for acid-fast bacilli in 24 reacting sheep it has been possible to find organisms indistinguishable from *M. paratuberculosis* in 15 cases. The intradermic johnin test will not detect all animals harbouring acid-fast organisms in the intestinal mucosa. In two cases from seven non-reacting sheep from infected flocks it was possible to demonstrate acid-fast organisms in intestinal smears.

The discrepancy between the reaction to johnin and the demonstration of acid-fast organisms in intestinal smears can in part be explained by the fact that not enough portions of the intestinal tract were examined. The finding of acid-fast organisms in tissue smears of non-reacting sheep offers the more serious problem in evaluating the test. This may be due to recent infection or to failure to interpret accurately the reaction of the tissue to the johnin. In some cases the tissue response to the antigen is very slight. It is now recommended that a retest be made after a lapse of 40 to 60 days.

It has been impossible to obtain very definite information on the economic significance of ovine Johne's disease. In flocks where both reactor and non-

reactor animals have been maintained the wool production and lamb production have been nearly identical in the two groups. There are so many other factors which contribute to the whole general picture that the segregation of the whole into various elements is difficult. Most of the flocks under observation have been composed of several different breeds. The incidence and effects of other diseases also play an important rôle. In many flocks of sheep the effects of parasitism have been as severe as any possible effect of Johne's disease. These observations are in agreement with those of Dunkin and Balfour-Jones.

McEwen's experiments indicate that sheep past the age of two years do not readily contract Johne's disease. This point has not been determined by carefully controlled experiments, but sheep of five to six years of age have become reactors to johnin during the past two years. The circumstantial evidence suggests that in certain individuals the "age immunity" may not develop. It is also possible that certain of these sheep were infected at the time of the early tests and failed to react.

The wide distribution of Johne's disease that seems apparent from preliminary surveys immediately raises the question of instituting control measures for handling this disease. At the present time there does not appear to be a satisfactory plan of procedure. The test and slaughter method would possibly be successful on carefully selected farms, but with this disease all species must be considered and the plan must be applied to the control of all livestock. There is a strong feeling among livestock men that after Johne's disease has become established the number of clinical cases will be low.

It is a common observation in nearly all flocks that good care, proper feeding, and the control of parasites has decidedly decreased mortality. There seem, however, to be irreducible losses with symptoms of clinical Johne's disease. Although these losses are only five per cent., as suggested by McEwen, they still constitute a serious drain on the sheep producer.

Control Measures

Clinical symptoms of Johne's disease are not common in flocks which are adequately fed and in which the internal parasites are controlled by medication and pasture rotation. In nearly all cases where symptoms ascribed to Johne's disease have been observed there has been a moderate to heavy infestation with some type of gastro-intestinal parasite. No medicinal treatment has been found effective in treating clinical Johne's disease.

Inter-species transmission of Johne's disease appears to take place when the animals are pastured in the same lots. On one farm where the same lots were used by cattle, sheep, and swine it was found that individuals of all three species reacted to the intradermic johnin test and acid-fast organisms have been demonstrated in the intestinal mucosa of all three. A high percentage of horses and mules tested have shown positive reactions to johnin. In one case a reacting mule was killed for examination but acid-fast organisms were not demonstrated.

Preliminary studies on porcine Johne's disease have indicated that the usual symptoms of Johne's disease rarely if ever develop in the pig. Numerous "reactor" swine have been examined post-mortem and acid-fast organisms have

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been demonstrated in the intestinal mucosa. The animals examined have never presented evidence of avian tuberculosis. At the present time we are inclined to regard Johne's disease-infected swine as possible dangerous carriers of the disease. It may be that swine suffering from heavy parasitism or malnutrition would also develop clinical Johne's disease, although it has not been observed in this laboratory.

The problem of Johne's disease control in the future is one of considerable importance. The test and slaughter method is economically unsound in many flocks. The incidence of the disease often exceeds 75 per cent. of the breeding flock. Since suckling lambs react to the johnin test it seems that a test and segregation plan would not be feasible. This applies particularly to those flocks maintained in crowded quarters. A larger flock was kept under semi-range conditions and found to have very few reacting lambs in both 1940 and 1941 crops. There is the possibility of eradication of the disease under such conditions. The small farm flock, however, does not appear to lend itself to such a plan of control.

In testing lambs with johnin it has been found that animals of five months old frequently react. A limited number of acid-fast organisms could be demonstrated in intestinal smears.

Summary

1. A high percentage of sheep have been found to react to the intradermic johnin test.

2. It has been possible to demonstrate acid-fast organisms in the intestinal mucosa of 15 of 24 reacting sheep.

3. It is sometimes possible to demonstrate acid-fast organisms in the intestinal mucosa of sheep that failed to react to johnin.

4. The inter-relationship between the symptoms of ovine Johne's disease and parasitism is discussed.

5. The possibility of inter-species transmission of Johne's disease is considered.

Abstracts of Current Literature

Sulphaguanidine Therapy for Calf Scours. By W. T. S. THORP and J. F. SHIGLEY. *Vet. Med.* 1942. *XXXVII*, 210.

SULPHAGUANIDINE, a sulphanilamide derivative, has a low absorption rate from the gastro-intestinal tract compared with other sulphonamides. The authors used the drug in the treatment of calves from a large dairy herd which showed clinical symptoms of scours and dysentery. The symptoms appeared in the calves when 8 to 12 days old and except for this drug the only other treatment was the administration of a bismuth compound. The drug was given in doses according to the weight of the calf and the total daily dose was divided into three equal parts, given morning, noon and night in ¼-oz. gelatine capsules. In all, 40 calves were treated. Three calves showed some evidence of toxicity: there was extreme nervousness and signs of colicy-like pain. The authors also studied the toxicity of the drug for calves in three animals. Three times the therapeutic dose was given. Two of the dosed calves showed symptoms in the morning of the second

day and the third later in the same day. The symptoms became more marked until the calves died or were killed. The first symptoms were extreme nervousness and evidence of pain in the flank and lumbar region. On the third day there was stiffness of the limbs and extreme nervousness. The calves could rise only with difficulty. By the fourth day the symptoms were more pronounced and the calves were hardly able to stand: there was a complete anorexia. They died or were killed on the fifth, sixth and eighth days, respectively. Post-mortem examination revealed gross lesions in the kidneys, which were œdematous and swollen. The cortical substance was yellowish-white and the medulla dark red. Small hæmorrhagic areas were also found. The microscopic changes in the kidney suggested a nephrosis, the prominent lesions being marked tubular distension, necrosis of the tubular epithelium and the occlusion of many tubules.

The following is the authors' summary of their work: "Forty calves diagnosed as having typical calf scours or dysentery were treated with sulphaguanidine. One of the calves did not respond to treatment and died of calf scours. The remainder showed a fair to very good recovery. The calves treated with sulphaguanidine did not appear to lose their appetite to such an extent or become as sick from the dysentery as those receiving other forms of treatment. The suggested maximum therapeutic dosages are as follows: Calves, 75 pounds and over, 0.15 to 0.17 gm. per pound of body weight per day, divided into three equal parts and given morning, noon and night; calves under 75 pounds, 0.13 gm. per pound of body weight, given in the same manner. The dosage for all calves should be reduced on the third day by 0.05 gm. per pound of body weight, and not over 0.06 gm. per pound should be given on the fourth day. An overdose of sulphaguanidine causes severe damage to the kidneys, manifested by a severe tubular nephritis."

Some Therapeutic Indications for the Use of Sulphathiazole in Small-Animal Practice. By A. H. Bryan. *Vet. Med.* 1942. *XXXVII*, 138.

Following detailed observations of cases the author concludes that in canine and feline distemper the use of sulphathiazole has given promising results. Sulphathiazole appears to be less toxic than other "sulpha" drugs: its action is not so drastic as that of sulphapyridine, although the latter, if it can be tolerated, appeared to check infections more rapidly than sulphathiazole. The doses of sulphathiazole used were the same as those of sulphapyridine, viz.: Large dogs, 50 to 60 grains daily (in 4 to 6 doses); toy breeds, 20 grains daily; cats, 15 grains daily. No toxic symptoms were found with these doses.

An Investigation to Determine the Sensitising Agent in Cattle Tested with Mammalian and with Avian Tuberculins. By W. H. Feldman and H. E. Moses. *Amer. Jl. Vet. Res.* 1942. *III*, 3.

In view of the increasing knowledge concerning the incidence of infection in cattle with avian tubercle bacilli, the following conclusions of the above authors, working in America, are of considerable interest. Attempts were made to demonstrate tubercle bacilli by culture methods and by the inoculation of guinea-pigs with the tissues of cattle that had reacted to avian or to mammalian tuberculin, or to both of these products. The total number of cattle tested was 3,073, comprising 99 separate herds in the state of South Dakota. One hundred

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and one animals reacted positively to the test (3.3 per cent.) and were slaughtered. Lesions considered at necropsy to be tuberculosis were present in 45 carcases, so-called skin lesions only were found in 16, while in 40, or approximately 39.6 per cent., no lesions of tuberculosis were observed. In 23 instances, all representing cattle in which lesions of tuberculosis were found at necropsy, tubercle bacilli were demonstrated. All strains were proved by animal pathogenicity tests to be of the bovine type. Although tuberculosis was present in the poultry on 23 of the 99 premises, the avian bacillus was not obtained from any of the tissues examined. From the data obtained it is concluded: (1) The previously recognised fact that many cattle presumably sensitised by bovine tubercle bacilli will react to avian tuberculin administered intracutaneously has been confirmed. In most instances, however, the reactions are less pronounced to avian than to mammalian tuberculin. (2) Among animals that react positively to either avian or mammalian tuberculin there occur a considerable number in which by the methods available the agent responsible for the sensitisation cannot be determined or is obscure. (3) The possibility that agents other than tubercle bacilli are capable of sensitising cattle to tuberculin should be re-examined. (4) The agent responsible for detectable lesions of tuberculosis in cattle in the great majority of instances is the bovine tubercle bacillus. The avian and the human types of the organism are of minimal importance. (5) Apparently it is difficult at the time of the necropsy to differentiate in some instances lesions of tuberculous adenitis from minimal lesions of adenitis due to ray fungus infections. (6) Regardless of possible shortcomings, the intradermic tuberculin test when properly applied and intelligently interpreted still remains the most reliable single method for the detection of infections of cattle due to the tubercle bacillus.

A Filterable Virus, the Cause of a Respiratory-Nervous Disorder of Chickens. By D. E. STOVER. *Am. Jl. Vet. Res.* 1942. *III*, 207.

THIS article deals with a disease in chickens in California. The birds become affected when 3 to 10 weeks old, though birds of younger or older ages may suffer. There is difficulty in differentiating between this disease and infectious bronchitis. As a rule, respiratory symptoms are soon followed by those of nervous disorder, e.g., muscular inco-ordination involving mainly the neck and legs with tremor of the body and paralysis of the legs. The cause appears to be a filterable virus as shown by filtration experiments, and is found in the air sacs, the lungs and the trachea. The disease was reproduced by inoculations of infective material intranasally, intratracheally, subcutaneously or directly into the crop. The difference between this disease and infectious bronchitis was shown by cross-immunity tests—and further, the disease was also proved, by similar methods, to be distinct from laryngotracheitis and from coryza caused by *Hemophilus gallinarum*.

Foot Rot of Cattle and its Relation to Diet. By C. C. HASTINGS. *N. Amer. Vet.* 1942. *23*, 90.

THE author points out that the so-called "foul in the foot" or foot rot of cattle is not often described in textbooks but is found frequently in dairy and beef herds. He says that during recent years it has not been uncommon to see practically 100 per cent. infection among fat cattle in the feed-lot. He also quotes

an instance in which 63 fat yearling heifers, confined in a small lot, were each affected. The seasonal occurrence of the disease is stressed—dairy cattle being affected more commonly in the winter and beef cattle in the late summer. Concerning the question of a diet deficiency being associated with foot rot in cattle it is stated that "while there is no experimental data to support the belief, years of observation and clinical study have led to the conclusion that the contributing cause of foul foot in cattle is usually a nutritional deficiency, with an insufficient intake of vitamin A playing the major role. Its regular appearance in herds receiving a suboptimum vitamin A diet cannot be ignored. In badly affected herds there is also quite frequently evidence of a calcium deficiency. It is entirely possible that the two factors, working together, create a favourable field for the growth of pathogenic organisms ever-present in feed-lots." The author finds that in herds fed a diet deficient in vitamin A the prominent symptoms are œdema, first in the forelegs and later involving the scapular region and possibly the whole body. In cases of œdema of the legs examination of the interdigital space shows an oozing of serum through the skin. The skin soon breaks, leaving a raw surface. Further, in calcium-deficient cattle there is a tendency for the hoofs to grow long and the toes to spread apart. Invasion of these affected parts with the bacillus of necrosis may often lead to the typical foot rot. In treatment, the author practises the correction of the diet, e.g., adding hay or grass containing sufficient pro-vitamin A carotinoids and sufficient calcium. His local treatment is described as follows: "A routine treatment that have proved uniformly successful consists of first thoroughly cleansing the foot and then removing all necrotic tissue and loose horn. Then swab the entire diseased area with a solution of six ounces of copper sulphate in a quart of 4 per cent. acetic acid. Follow this with a liberal application of powdered copper sulphate, cover with cotton wool and hold in position with a four-tail bandage. Leave the bandage on until it comes off without assistance. A second treatment is seldom necessary."

Pro Patria Mori

VETERINARY students are reserved from military service, yet there are some to whom such reservation is galling, and they seek the ways and means of participating more actively in the conflict.

It is no easy matter for them to enter the Forces, and when they do it is only natural that such brave spirits shall be in the forefront and that some will make the supreme sacrifice.

Two such boys were Hill and O'Reilly, third-year students at the Royal Veterinary College. Both have gone and it is but right that the profession should record their great endeavour.

Rowland Bertram Dunstan Hill was born at Meerut, India, on October 15, 1920. He was educated at St. Joseph's College, Naini-Tal, and Bishop Cotton School, Simla. He entered the R.V.C. in October, 1937, and enlisted in the R.A.F.V.R.

in June, 1940. He became a sergeant-pilot of Bomber Command in June, 1941. He was engaged in operations until September 7, 1941, when he was killed in action.

Beresford Laurence O'Reilly was born on May 30, 1918, at Chittagong, India. He was educated at St. Joseph's College, Naini-Tal. In 1929 he came to England and continued his education at Prior Park, Bath. At school he proved to be an all-round athlete, gaining the rugger and cricket colours. In 1935 he toured Germany with the school team. He entered the R.V.C. in October, 1937. In July, 1939, he joined the R.A.F.V.R. and he was called up in May, 1940. After preliminary training he was posted for further training in Rhodesia in August, 1940, under the air training scheme. He returned in March, 1941, and after further final training he was posted to a Bomber squadron. On July 15, 1941, he was on a sortie over N. France when the Stirling bomber which he was piloting was shot down by A.A. fire. He was buried at Boulogne.

These two boys were friends. They were in the front rank in all the social activities of the college. Both paid us visits shortly before their deaths. Hill flew low over Sonning, so low that many recognised his ginger head. A wave of the hand and he was gone.

O'Reilly came to see us and spent a few hours. He was full of enthusiasm and anxious to "Get at Jerry."

We will treasure their memory.

J. McC.

APPOINTMENT

Dr. W. S. Gordon, Ph.D., M.R.C.V.S., F.R.S.E., has been appointed Director of the Field Station of the Agricultural Research Council at Compton, near Newbury, Berks., in succession to the late Mr. G. W. Dunkin.

Dr. Gordon is 40 years of age and has been Senior Bacteriologist on the staff of the Animal Diseases Research Association, Moredun Institute, Gilmerton, Midlothian, since 1930. He was previously a veterinary bacteriologist at the Wellcome Physiological Research Laboratories and prior to that he was an inspector on animal diseases on the staff of the Ministry of Agriculture and Fisheries. He qualified M.R.C.V.S. at Glasgow Veterinary College in 1923.

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Beresford L. O'Reilly.

Rowland B. D. Hill.